



# Big Surprises: Jackpot Reinforcers in Research and Practice

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## Abstract

Unusually large, infrequent reinforcers, described as jackpots, are the subject of considerable discussion among applied animal behaviorists. Such reinforcers offer considerable promise in applied behavior analysis as a means of both potentiating training of new responses and response classes and enhancing previously learned ones. The concept of jackpot reinforcement, however, is rife with not only a lack of definitional and procedural clarity but also a paucity of research, either basic or applied, on such reinforcement. Considerations in undertaking such research include defining the parameters of jackpot reinforcers, identifying suitable dependent variables, and creating experimental designs appropriate for their assessment. The few experimental analyses of jackpot reinforcer effects on either response acquisition or maintenance have produced little evidence of systematic effects, despite the use of several different methods and behavioral measures. Negative results could reflect either the absence of systematic effects of these jackpot reinforcers or unsuitable methods of analysis. Only further research will take the topic of jackpot reinforcers beyond opinion and testimonial and into the realm of the science of behavior.

**Keywords** Behavioral effects · Jackpot reinforcers · Reinforcer magnitude · Standard reinforcers · Surprise

I do not have data to back up my assertion, but I can imagine that when working with a young child on a task that has been difficult for him or her, when the child finally succeeds (or makes a good approximation to success), the therapist might become *super*animated with lots of “wows,” “way-to-goes,” and maybe even a high five or two. In other words, the child receives a surprising, big, super-, mega-, or what is known in some circles as a jackpot, reinforcer. In my own work with pigeons, when shaping a response, I have observed myself delivering particularly long-duration access to the food hopper after what I judge to be a stellar approximation to the target response. Despite what I suspect to be a common occurrence

in working with the behavior of whatever species, the only applied behavior analysts who seem to have given much attention to jackpot reinforcers are those working in the field of animal training, where these so-called jackpot reinforcers loom large. However, as many applied animal behaviorists also acknowledge, both the conceptual and empirical foundations of jackpots are on less than firm ground. Evidence of their behavioral effects is largely anecdotal, and support for the idea of jackpot reinforcers having unique effects is somewhat counter to the findings of basic research. Nonetheless, if they do have the potentiating effects on learning and performance that some have claimed and others have implied, they could be of great value to applied behavior analysts beyond those involved in applied animal behavior work. The purpose of this review is to define jackpot events, critique their use and analysis, review the existing experimental investigations of their effects, and consider their future in applied behavior analysis.

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## What Is a Jackpot Reinforcer?

Jackpot reinforcers were described originally by Karen Pryor in her popular, influential 1984 book, *Don't Shoot the Dog*. In her original characterization of jackpot reinforcers, she defined them as “a reward that is much bigger . . . than normal

reinforcement, and one that comes as a surprise to the subject” (p. 31). The three elements of this definition—reinforcement, size, and predictability—warrant detailed consideration.

**Reinforcement (the Response-Reinforcer Dependency)** A defining feature of a reinforcer is its dependency on the response that precedes it (Catania, 1991; Cooper, Heron, & Heward, 2007; Mazur, 2017; Michael, 1982). Without this dependency, responding is reduced, sometimes to zero (e.g., Carr et al., 2000; Lattal, 1974; Zeiler, 1968). In the case of jackpots, there now seems to be general agreement among applied animal behaviorists that the jackpot should be response dependent. Following several years of confusion over the necessity of the response-reinforcer dependency in arranging jackpots, largely resulting from Pryor’s (1984) original definition, she clarified the issue by noting that a jackpot is “a surprisingly big reinforcer, delivered contingently. The key is in the word, *contingent*. To reinforce a particular behavior, a jackpot has to appear, and be perceived by your learner, *while* the learner is doing that particular thing you want” (Pryor, 2006). Gomes (2017; see also Farricelli, 2014) similarly observed that “a jackpot, when used correctly, should be an astonishingly big reinforcer, delivered contingently.” Although these definitions are clear enough, turning to examples given in practice tells a somewhat different story.

As one example of a jackpot, Pryor (1984) described an unexpected Christmas party given by her boss “for no special reason,” (p. 31), which had a positive effect on employees. Later in this same section of the book, she mentioned a trainer giving two fish to a dolphin “for nothing” (p. 32), with the dolphin being “startled by this largesse” (p. 32). Thereafter, the dolphin resumed responding. In both of these examples, the events were not dependent on a response, but in at least the latter case, the fish were specifically targeted as making the subsequent response more likely. Similarly, and despite Pryor’s (2006) subsequent clear articulation of the importance of the response-reinforcer dependency, some applied animal behaviorists offer examples inconsistent with Pryor’s admonition that jackpots must be response dependent:

My first exposure to the use of a jackpot dates back many decades. As a young trainer working with dolphins in a small marine life park in Texas, I used a variety of fish as reinforcers. One of the dolphins’ favorite fish was mackerel, but, for a variety of nutritional reasons, each dolphin was only allowed one of those large fish each day. It was a highly valued reinforcer for the animals, and we reserved it for special breakthroughs in training. When one of us was training a new behavior, we would argue among ourselves to see

who would get to use the fish for their sessions. When a behavior had problems meeting criteria, *we reserved the fish for when the animal did particularly well meeting all criteria that day*. We called this reinforcer the “fix-it” fish; the director of training told us that it was called a jackpot. As a young trainer, I remember marveling at the value of this magic reinforcer. (Ramerez, 2017; emphasis added)

Ramerez (2017) thus suggests ending a session with a jackpot. Other authors have suggested the value of starting or ending a training session with a jackpot:

When a large reward is offered in the beginning of a training session it can motivate the animal and increase interest in the task. It can make the animal increase its activity level and it can trigger subsequent variable behaviour. (Fisher, 2009, quoted by Gomes, 2017)

In these examples, it does not seem that the reinforcer depends on a specific response, as Pryor’s (2006) definition specified, for reinforcer delivery occurred only if the emphasized criteria were met. With a little imagination, these examples could be construed as broadly response dependent. It could be suggested, for example, that there may have been a molar contingency between responding and the “highly valued reinforcer” (see Kuroda & Lattal, 2018, for an example of the effects of such molar contingencies on responding) when it is delivered at the end of that particularly productive training session. It also could be that the jackpot functions like an accumulation contingency (e.g., DeLeon et al., 2014), whereby the participant earns reinforcers but postpones receipt until the end of the session. These examples do not *seem* to be what the writer had in mind, but these two options could, in a post hoc manner, rescue the general sense of the dependency. Yet another potential way of salvaging the response-reinforcer dependency concept is to consider the performance during the entire session as the operant, as when children engage in solving math problems for a class period and receive a reinforcement at the end of the period based on their overall performance. This still requires measurement and a demonstration of behavior change resulting from the consequence at the end of the period.

The upshot of all of this is that we are left with some ambiguity, at least in terms of use if not in theory, as to whether jackpots are to conform to the conventional definition of a reinforcer as a response-dependent stimulus that positively alters response probability—or whether they are, with apologies to the animal trainers noted previously, employing tasty *pisces* as jackpots at the end of the day, a different kettle of fish altogether.

A final point concerning the reinforcement dimension of jackpots is that in her definition (see the previous section “What Is a Jackpot Reinforcer?”), Pryor seemed to conflate rewards and reinforcers. Rewards might more usefully be considered as events that have been shown to function as reinforcers for a specific class of behavior in the past, but that may or may not function as reinforcers for the particular class of behavior currently of interest. Knowing something is a reward—that is, has functioned as a reinforcer in the past—may give us a clue as to its likely effect on present behavior, but a functional analysis is required to establish the reward as a reinforcer for the response of current interest. Thus, reward might be considered to be a more structural event and reinforcer a more functional one, in that only the latter is specifically related to present behavior. In the case of jackpots, then, events previously shown to be reinforcers for other behavior *might* function as reinforcers on a grander scale for current behavior.

**Size matters** The definitions previously reviewed all suggest the importance of the title of this subsection. A jackpot means that it is in some sense “more” than the conventional reinforcer, but “more” is left rather open ended. In practice, jackpot reinforcers sometimes have been “much more of the same” reinforcer used to maintain the behavior, and at other times they have been qualitatively different from the reinforcer ordinarily used to shape or maintain the behavior. The relative efficacy of these different arrangements of jackpots is another unknown dimension of the jackpot reinforcer.

Typically, the quantitative dimension of “bigness” is organized in behavior analysis around the parameter of the amount of reinforcement, which itself is multidimensional. Amount of reinforcement incorporates several specific manipulations. It can refer to the concentration of a reinforcer (a 10% vs. a 35% sucrose solution), the volume of a reinforcer (10 ml of water vs. 35 ml of water), the number of units delivered (one token vs. three tokens), the duration of reinforcer access (30-s access to a preferred toy vs. 5-min access to that toy), or some more general quantitative difference (e.g., a small teddy bear vs. a large teddy bear). With each of these parameters, the bigness of the reinforcer is a relative concept. In terms of numbers, Pryor (1984) suggested that a jackpot reinforcer be 10 times the size of a normal reinforcer. Dennison (2011, cited by Farricelli, 2014) upped the ante to 10 to 30 treats. These guidelines seem to be based on the authors’ experiences in animal training and not on any systematic, objective analysis.

A challenge of larger and smaller qualitatively similar reinforcers is that their behavioral effects are somewhat erratic, whether the difference is specified as number or duration. When comparing concurrently available reinforcer magnitudes (e.g., food hopper access of 2 s vs. 8 s), the larger reinforcer maintains more responding than does the smaller one (e.g., Catania, 1963; Davison & Hogsden, 1984). The

situation is different, however, if the different durations are presented individually across successive conditions, which is closer to how jackpot reinforcers are described as being presented (i.e., rarely and as replacements for standard reinforcers). Oliver, Nighbor, and Lattal (2018), for example, found that four food-pellet reinforcers delivered to rats on variable-interval schedules following lever presses produced response rates no higher than those obtained with one-pellet reinforcers. Reinforcer duration (time a reinforcer is accessible, as in time allowed to play with a video game or toy) sometimes yields effects in the predicted direction (e.g., Perone & Courtney, 1992), but in parametric experiments examining the effects of duration on schedule-controlled responding, the behavioral effects of different durations of reinforcer access are, as noted previously, mixed (e.g., Bonem & Crossman, 1988; Lerman, Kelley, Vorndran, Kuhn, & LaRue, 2005). Furthermore, if duration becomes too long, then one must consider the effects of satiation, a point also made by applied animal behaviorists with respect to jackpot reinforcers. Another consideration is that there are two aspects to a timed reinforcer: Regardless of its duration, a response starts the reinforcer cycle, defining its onset. Once started, the reinforcer presentation continues for the designated duration. Thus, reinforcers of whatever duration share in common the fact that a response initially produces the stimuli associated with the reinforcer. Perhaps the reason that different reinforcer durations studied sequentially often yield the same effect is that the onset of all of them is the same. Onset may trump duration because going from no reinforcer present to reinforcer present may be more salient than are differences in duration, which are manifest and detected only sometime after reinforcer onset.

Qualitative differences between reinforcers are another dimension of bigness that often is discussed in relation to jackpot reinforcers. This dimension overlaps somewhat with quantitative variables like concentration and perhaps the aforementioned teddy bear example. The mackerel used by Ramirez (2017) described in the previous quote is an example of a qualitatively different jackpot reinforcer. The provenance of the qualitative differences aside, a Raggedy Ann may maintain responding in some sense better than a Ken doll, or vice versa. Applied behavior analysts routinely establish the relative efficacy of qualitatively different reinforcers with preference assessments. In the case of jackpot reinforcers, one might, for example, establish the most preferred reinforcer in a preference test (e.g., Fisher, Thompson, Piazza, Crosland, & Gotjen, 1997) and use the second- or other somewhat less preferred one as the reinforcer for the target response, reserving the most preferred choice to be the jackpot. Indeed, simply because a reinforcer is not the most preferred of several available items does not mean that it is not a reinforcer. Ramirez (2017), quoted previously, suggested that the jackpot reinforcer was “highly valued” by the recipient. One cautionary note

in describing reinforcers in this way is that value also is a relative term and not a property of the object itself. We describe a reinforcer as being more valued relative to another reinforcer. As noted previously, this is familiar territory for applied behavior analysts, who often rely on preference assessment outcomes, which provide relative measures, in selecting reinforcers.

**Surprise** The definition of a jackpot reinforcer calls not only for it to be big but also for it to be a big surprise. Stripping away the cognitive and emotional connotations of surprise leaves probability as a more measurable and programmable dimension of this element of jackpot reinforcement. Applied animal behaviorists seem to have at least implicitly adopted this operational definition of surprise because they recommend not overusing jackpot reinforcers lest they lose their function (Burch & Bailey, 1999). Farricelli (2014) went a step further, maybe beyond the pale, and suggested that users “consider that too many jackpots may at the same time cause disappointment when you’ll deliver regular reinforcement.” Her cautionary note, however, does have research support in the form of negative incentive contrast (Flaherty, 1982), whereby small reinforcers preceded by larger ones control lower response rates of rats than do those same reinforcers if preceded by reinforcers of the same size. This element of surprise is familiar to learning theorists. Support for it can be found in associationist learning theory, where surprise also is considered an important element when establishing new behavior (e.g., Rescorla & Wagner, 1972).

There is no empirical evidence to suggest how infrequent is infrequent enough to retain the element of surprise, or how one would assess whether the infrequency was sufficient. Although intuitively it seems reasonable to not overdo a good thing, or, more precisely in the present context, a big thing, limits and guidelines seem to be imposed as intuitively as the concept itself. Pryor (2006) made the following statement concerning frequency of jackpot reinforcers in the context of comparing them to large response-independent reinforcers: “Like the jackpot, a non-contingent reward is a tool to use rarely. And, like a jackpot, if it is going to work, *you only need to do it once*” (emphasis added). If this statement is to be taken literally, then a jackpot might be used only once, seemingly undermining the idea of reinforcing exceptional behavior. In the case of acquisition, the behavior and the criteria for reinforcement are constantly changing. It does not seem useful to select only one instance for a jackpot and not use it thereafter, for the best (approximations) may yet to be. Using something only once also makes it impossible to assess if it is actually a reinforcer. With maintained responding, a single delivery of a reinforcer would seem to have only a transient effect, but intermittent, infrequent jackpots might have more lasting effects.

**Arranging jackpot reinforcers** In addition to their dependency on a response, size, and rarity, other dimensions of delivering jackpot reinforcers have been discussed by those using them. Although there is general agreement that the jackpots should occur rarely, some writers have suggested that they are most effective if they occur at the beginning or very end of a session. The former is said to activate the subject (Fisher, 2009, cited by Gomes, 2017) and the latter to allow some type of consolidation to occur (Ramerez, 2017). Others, like Pryor (2006, cited previously), advocate their use when there is an “exceptional” response. It may be that jackpots can be applied usefully in all of these ways, but the various recommendations and suggestions as to where to place them within a training session again point to the need for experimental analysis to replace opinion and experientially based advice.

Another dimension about which there are inconsistencies is whether a jackpot should be delivered all at once or doled out in smaller chunks. Farricelli (2014) noted that “some consider a jackpot as giving a series of treats one-by-one, others consider jackpots as access to a pile of treats and some others think that jackpots simply consist of the delivery of higher value treats.” Killon (2007) recommended that

it is much more effective to dole out 20 small treats in rapid succession than to give one large chunk of bait . . . 50 tiny pieces of food is much more valuable to a dog than one softball sized treat that they can consume in one bite.

One problem with doling out jackpots in small amounts is that this method extends the reinforcement period, leading Farricelli (2014) to suggest that

a possible solution to shorten the time span between behavior and reward is to stop doling out a series of treats one-by-one and rather allowing the dog to wolf down treats from a stuffed treat bag or opening your hand and unraveling a pile of treats.

In an experiment conducted in my laboratory, Anthony Oliver, Michael Sheridan, and I (unpublished) compared both the behavioral effects of and preference for a series of brief sequential presentations of food to pigeons following key pecks maintained by a variable-interval schedule to those of a single food presentation of a duration equal to that of the series of brief sequential reinforcer presentations delivered under otherwise identical conditions. There were no differences in response rates controlled by or preference for either of the two ways of presenting the reinforcer.

Jackpots were developed and often are discussed in the context of clicker training (e.g., Pryor, 2006), whereby each reinforcer is preceded by a brief sound that, depending on

one's theoretical orientation, functions either as a conditioned reinforcer or as a marker of the relation between the response and reinforcer (e.g., Lieberman, McIntosh, & Thomas, 1979; Williams, 1994). Farricelli (2014) frowned on using clickers preceding jackpots, suggesting that a "jackpot given after the click doesn't provide information on the behavior performed, it just tells the dog 'sometimes my owner gives me more treats than usual.'" Citing Pryor (2006), Gomes (2017) made a related point in his observation that "the jackpot has to appear while the animal is doing the behaviour, not afterwards." Thus, there seems to be some concern among animal trainers that there not be a delay between the response and the jackpot delivery, a reasonable concern in light of the known effects of delays of reinforcement (Lattal, 2010).

### Effects of Jackpot Reinforcers on Behavior

Having considered in the preceding section what jackpot reinforcers are, we turn to the question of what these reinforcers do—their effects on behavior. Cutting through the anecdotal comments about the effects of jackpots on affective and informational variables, the true test of the jackpot is whether it differentially affects behavior. In fact, from a functional perspective, for a reinforcer to function as a jackpot, it would seem necessary for it to have a greater behavioral effect, however measured, than would the standard reinforcer. There is, however, relatively little discussion of the actual behavioral effects of jackpot reinforcers, and even less data (see also O'Heare, 2016). Rather, most of the discussion and debate in the applied animal behavior literature seem to focus on the form of and procedures for delivering jackpots. Speaking generally, jackpots have been suggested to have both strengthening and motivating effects on behavior. Assessing both of these processes requires knowing what to measure and how to measure it, to which we turn before considering these two suggested functions of jackpots.

Pryor (1984) suggested that "a jackpot may be used to mark a sudden breakthrough" (p. 31). Pryor (2006) later stated that she would use a jackpot "to both mark and strongly reinforce the first occurrence of a rare behavior, or the first achieving of a difficult move." Farricelli (2014) suggested that "jackpots are used to reward . . . *exceptional* performances of behavior" (emphasis in original).

As noted previously, when one presents a jackpot reinforcer, behavior should be changed in ways that are different from those produced by standard reinforcers. Thus, any assertion of the differential effects of jackpot reinforcers must involve a comparison of jackpot and standard reinforcer effects. These comparisons require either a baseline, a control group, or some type of normative sample revealing the effects of the standard reinforcer against which the effects of the jackpot can be compared when administered under otherwise similar

conditions. Such comparisons are largely missing from the jackpot literature.

Even though learning is a continuous process from the initial steps of shaping to the final sustained performance, it may be useful to distinguish response acquisition and response maintenance for the present discussion. Sidman (1960), for example, identified transient and steady states, the former associated with acquisition, among other things, and the latter with maintenance. As he suggested, each state type requires different methods for analysis, particularly when attempting to identify parametric differences in behavioral effects as in those between a jackpot and a standard reinforcer.

**Jackpot reinforcement during acquisition** During acquisition, there is no steady state; behavior is fluid and constantly changing toward the terminal response. As a result, there is no turning back once the acquisition process starts, creating unique challenges for individual-subject design and assessment. A notable example of the experimental analysis of acquisition is an experiment by Eckerman, Hienz, Stern, and Kowlowitz (1980), who showed that shaping the location of a pigeon's key peck proceeded "most efficiently with rapid, relatively large shifts in criterion performance" (p. 299).

Conventionally, researchers might use a between-group comparison to assess jackpot reinforcer effects relative to their absence. An example of such an experiment, often cited among animal trainers, was described as follows:

Dog trainer Elizabeth Kershaw (2002) conducted a dog training experiment that tried to measure the effects of magnitude of reinforcement after the click when dogs are learning a new task. She had two groups of dogs learning to touch a cone with their nose and with their paw. One group progressed through criteria with one click and one treat all the time (constant group), whilst another group progressed through criteria with one click and one treat most of the time and an occasional click and delivery of larger reinforcement amounts (jackpot group). Overall, significant differences in performance between the two groups could not be detected. (Gomes, 2017)

There are a few experiments in peer-reviewed journals in which small and large reinforcer effects on acquisition are compared (see, e.g., Doughty, Galuska, Dawson, & Brierly, 2012), but nothing on jackpot reinforcer effects on acquisition.

The difficulty with between-subject comparisons in the analysis of shaping a response is that no two shaping sequences are identical. Reinforcers are delivered not according to a predetermined schedule, but rather based on the subject's performance. Thus, an *in vivo* comparison between jackpot

and conventional reinforcers would, at best, potentially differ across several dimensions simultaneously. Another experimental solution might be a repeated-acquisition design (Boren & Devine, 1968; cf. Harlow, 1949). In this procedure, a particular sequence of responses is learned over several trials. Once the sequence is learned, a new sequence is substituted, and so forth. The procedure in essence allows a steady-state analysis of acquisition. In assessing jackpot reinforcers, some sequences might include occasional jackpot reinforcers and others not, allowing a direct comparison of the jackpots relative to their absence on response acquisition. A related molecular-level analysis might be to compare the post-jackpot delivery behavioral effects to those following a standard reinforcer. As with the between-subject comparisons, however, there might be considerable variability in the postreinforcer effects depending on where in the course of acquisition they are assessed.

**Jackpot reinforcement and steady-state responding** An everyday example sometimes cited in the applied animal behavior literature on the effects of jackpot reinforcers on steady-state behavior is playing a slot machine:

You insert a coin and press the button on the front panel or pull down the lever and watch the reels spin with high hopes. Lemons, cherries and bells flash quickly before your eyes. The reels soon start spinning more slowly as you hold your breath hoping for a winning combination. Unfortunately you do not win. You try again and again, until at some point you hear bells ringing and music playing as flashing lights surround you. After a few seconds of disbelief, your heart starts pumping faster as you realize you have just won the jackpot! (Farricelli, 2014)

This example suggests a prior familiarity/history with slot machines, making the response well established in the player's repertoire, and thus an instance of jackpot effects on maintained responding. (Note that for the jackpot to be considered a jackpot reinforcer, one must assume that other, likely qualitatively similar, reinforcers are maintaining slot-machine playing at other times.)

The first question to ask with respect to the maintenance effects of jackpots is that of measurement. The standard measure of behavior change is response rate. Other measures could be latency to responding, changes in response characteristics (e.g., interresponse times, the mean of which is the reciprocal of response rate; response topography, response location, response patterns in time), and the resistance of responding to change (e.g., Nevin, 1974).

In a series of experiments, Kuroda, Roca, Hall, Jarmolowicz, and Lattal (2020) examined the effects

of jackpot reinforcers that were either quantitatively (longer) or qualitatively different in different experiments on operant responding maintained under different conditions. Substituting occasional, longer duration jackpot reinforcers for standard ones had no systematic effect on latency to respond, response rate, or response patterns when key-peck responding of pigeons was maintained by fixed-interval reinforcement schedules relative to the effects of the standard reinforcer (Kuroda et al., Experiment 3). Muir (2010) reported a similar finding in an unpublished master's thesis for single variable-interval schedules studied with dogs as subjects. In Kuroda et al.'s (2020) Experiment 5, responding also was maintained by standard reinforcers in one component of a multiple fixed-interval fixed-interval schedule schedule, and occasional jackpots were added in the other component. When response-independent reinforcers were delivered during a blackout separating the two components (cf. Nevin, 1974), the resistance of responding to disruption by the response-independent reinforcers was the same with and without the added jackpot reinforcers. Both Muir (2010) and Kuroda et al. (2020, Experiment 4) found mixed evidence for a differential preference for a condition with a jackpot reinforcer associated with it. Kuroda et al. found such an effect for only one of two subjects, and Muir (2010) similarly found modest but unsystematic preferences for the jackpot condition.

**Motivational effects of jackpots** As noted previously, even after clarification by Pryor (2006), there remains discussion about whether to consider response-independent events in discussions of jackpot reinforcers. The examples given in the "Reinforcement (the Response-Reinforcer Dependency)" section illustrate some of these discussions. The example of the dolphin goaded to action when the trainer gave it two fish "for nothing" is one example. Fisher (2009) suggested that "a jackpot can motivate a dog to activity when he doesn't seem interested" and that an appropriate time for a jackpot is "at the start of a training session. I give a jackpot to a new dog I'm training to motivate the dog to work for me." In none of these examples is the jackpot referenced to a specific response. If the dog is not "interested" in behaving, then it seems likely that no response is involved in the jackpot reinforcer delivery. With respect to the second quote, Farricelli (2014) offered the following accurate assessment:

If you are dealing with a very shy dog that is very tentative in trying new behaviors and is undergoing a moment of discouragement, you may find that giving several, good tasting treats may perk her up and get her going again. But in this case, you're not giving a jackpot as you're not marking any particular behavior, what you're really doing is giving a non-contingent reward.

Such practices are common in many settings where behavior analysts work. In the laboratory, for example, it is not uncommon to be making progress in the shaping of a response when, for reasons unknown, the subject simply stops responding. Under these conditions, many shapers will simply deliver a few extra pellets or raise the hopper several times in a row to try to induce activity that then can be reinforced.

Pryor (2006) continued to stress the motivational value of response-independent jackpots: “Like the jackpot, a non-contingent reward is a tool to use rarely. And, like a jackpot, if it is going to work, you only need to do it once.” Others have gone Pryor one better (or worse, depending on one’s perspective) by adding an anthropomorphic/cognitive/affective function to the jackpot, as in Burch and Bailey (1999), who described jackpots as making the animal “excited and curious about what might be coming next” (p. 44).

All these descriptions are of motivational effects, and, minus the cognitive/affective language overlay that often clouds such descriptions, in behavioral terms they can be related to Michael’s (1982) concept of the establishing or motivating operation. Motivating events are not response dependent; rather, they are antecedent to the response to be affected by the reinforcer. As antecedents, it is erroneous to characterize these jackpots as reinforcers. They may well be, however, discriminative stimuli that set the occasion for the response to be reinforced.

Following the reinforcement and subsequent extinction of a response, reinstatement of that response occurs when the previous reinforcers are presented independently of responding (Campbell, Fixsen, & Phillips, 1969; Reid, 1958). Because such reinstatement might be useful as a model of how jackpot reinforcers serve the previously described antecedent, discriminative, or motivating function, Kuroda et al. (2020, Experiment 1) examined whether jackpot events were more likely to reinstate extinguished responding than were standard reinforcers. Lever pressing by rats was first reinforced with 45-mg food pellets on a variable-interval schedule and then extinguished. After responding was near zero, either a standard reinforcer (food pellet) or a dipper-full of sweetened condensed milk was delivered independently of responding (according to a variable-time schedule) at the same rate as were the pellets during the earlier variable-interval schedule. Reinstatement of lever pressing was for the most part limited to the variable-time food pellet conditions. That is, the jackpot milk reinforcers failed to reinstate responding. In the language of jackpots, it did not “motivate” the response, bringing up another issue with respect to the putative motivating function of the jackpot. It seems that a jackpot event may be more likely to reinstate responding if it first is established as a reinforcer by making it dependent on a response. Even relatively highly valued events are endowed with discriminative stimulus properties for reinstating responding (Reid, 1958) only if they have a history of being produced by the response

to be reinstated. Pryor, however, might fairly criticize this experiment by claiming that the jackpots occurred too frequently (even though there are no empirical guidelines to suggest an appropriate frequency). Kuroda et al. (2020, Experiment 1) therefore considered only the first delivery of the jackpot, with identical findings to those reported previously. As a further test of jackpot versus standard events reinstating low-probability responding, Kuroda et al. (Experiment 2a) maintained key pecking of pigeons on a progressive-ratio schedule in which the number of responses required for a reinforcer increased following each reinforcer. Under this schedule, a response requirement is reached that does not sustain responding: the so-called break point. When a pause in responding occurred that was 0.76 of the break point (thus near, but not, the pause required to end the session), a single long-duration (10 s as opposed to the normal 3 s) food reinforcer (grain) was presented independently of responding (cf. Kincaid & Lattal, 2018). There were no systematic differences between a long- and a standard-duration food presentation delivered independently of responding in reinstating such responding.

### Potential Negative Effects of Jackpot Reinforcers

Although it is not necessarily a problem with jackpot reinforcers, it was previously noted there is a potential for satiation if they are overused, which is another reason to recommend their rarity. Such satiation effects also would confound the assessment of their efficacy relative to standard reinforcers.

The removal of a large reinforcer under some conditions can result in negative incentive contrast (Flaherty, 1982; O’Heare, 2016), described in the section on “Surprise.” Although they used a chronic preparation in which large and small reinforcers followed one another in quasi-random sequences, Perone and Courtney (1992) found no evidence of longer postreinforcement pausing on a fixed-ratio schedule after a small reinforcer compared to that after a large reinforcer when the discriminative stimuli were the same in the presence of either reinforcer. This finding has been repeated across different schedules and response requirements.

Some animal trainers have suggested that jackpot reinforcers can take time away from training and have questioned whether there is sufficient gain in using them relative to the training time lost by their consumption. This depends, of course, on what the reinforcers are and how they are delivered. It obviously and by definition takes longer to play with a doll for 1 min than it does for 30 s. The longer duration the child plays with the doll also may make removal of the doll more disruptive.

A final negative consideration in using jackpot reinforcers is that we do not know whether they work or not. Using them could be of benefit, or it could be a waste of time. Practitioners using as treatment something unproven and potentially

ineffective—if the extant evidence is to be believed—could also be potentially violating professional and ethical standards.

## Conclusion

The biggest surprise about jackpot reinforcers is that there is so little substantive research on the topic, either in the animal or human laboratory or in work with human clinical populations. The promises of jackpot reinforcers seem to be big gains, enhanced performance, and happy campers. The reality is the big surprise just stated, which is worth restating: Although they are often touted and praised, there is little empirical analysis of the effects of jackpot reinforcers.

Jackpot reinforcers might seem intuitively likely to have differential effects relative to standard reinforcers. It is difficult not to warm to the idea of having a supereffect on behavior simply by occasionally “surprising” the subject or client with a supersized reward or reinforcer. Because of their potential, they certainly seem worthy of further consideration by behavior analysts working with many different populations and problems. Conceptually, however, jackpot reinforcement seems muddled and rife with confusion. (For example, if one jackpot is enough, as Pryor, 2006, has suggested, then how can it be a useful tool in dynamic behavior-change environments?) Conceptual clarity can often be achieved through experimental analysis, which would also shed light on the validity of the behavioral effects of such large, infrequent reinforcers. To date, the research on jackpot reinforcers has yielded inconsistent to negative effects. On the one hand, negative results must always be interpreted with caution because it may be that the conceptualization of jackpot reinforcers and/or the designs of the experiments used to test their effects were flawed in the first place, in which case negative results might be expected. Some of the problems in designing experimental tests of jackpots on response acquisition or maintenance have been described. Given that they are not resolved, it is unfair to conclude that jackpots do not affect behavior any differently than do standard reinforcers. On the other hand, if negative outcomes of tests of jackpot reinforcement continue to accumulate, at some point it will be time to “cry uncle” and declare jackpots as an interesting idea that just did not pan out.

This review is not intended to be a criticism of the concept of jackpot reinforcers. Rather, it is an applied behavior-analytic call to arms. Many applied animal behaviorists have suggested the potential and realized value in jackpot reinforcers in shaping, maintaining, and motivating behavior. Others have been more circumspect and made a similar call for the needed research (e.g., Ramerez, 2017). If valid, jackpot reinforcers could be an exceptionally useful tool in the armamentarium of practitioners of the science of behavior with humans. Their analysis also might have relevance to addictive

gambling. If they do not have the effects they are touted to have, then this also would be valuable information. Not only would we then know that they are not worth our time and trouble, but, more importantly, we would avoid being in the ethical bind of advocating treatments that do not work. The only way to determine the future of jackpots in basic and applied behavior analysis is to replace intuition, anecdotal reports, and testimonials by doing the research to find out.

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## Compliance with Ethical Standards

**Conflict of Interest** There were no conflicts of interest.

**Ethical Approval** Procedures performed in experiments involving animals and conducted in the author’s laboratory were in accordance with the ethical standards of West Virginia University.

**Informed Consent** Informed consent is not relevant to the research described in this article.

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